



# Allergic diseases, excessive Internet use and suicidal ideation in Korean adolescents

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## Abstract

**Objective:** The aim of this study is to evaluate the relation between suicidal ideation, allergic diseases, and excessive Internet use in Korean youth using a national representative dataset.

**Methods:** Data from the Korean Youth Risk Behavior Web-Based Survey (KYRBWS), conducted by the Korean Centers for Disease Control and Prevention, were used in this study. Complex sample logistic regression and structural equation modeling were performed to define the relation between suicidal ideation, allergic disease and excessive Internet use.

**Results:** A total of 73,238 students participated in this survey. In Korea, 19.3% of adolescents had suicidal ideation in the previous year. Asthma (OR = 1.23, 95% CI = 1.15–1.32,  $p < 0.01$ ) and allergic rhinitis (OR = 1.17, 95% CI = 1.11–1.22,  $p < 0.01$ ) were identified as risk factors for suicidal ideation after adjusting for school and family factors. Structural equation modeling showed that excessive Internet use interacted with the association between allergic diseases and suicidal ideation.

**Conclusion:** Allergy problems could positively affect suicidal ideation in Korean adolescents. Excessive Internet use could be a mediating factor between allergic disease and suicidal ideation.

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## 1. Introduction

Suicide is one of the leading causes of death in adolescents and remains a public health issue worldwide [1,2]. According to a 2010 report by Korea Statistics, suicide-related mortality had reached 31.2 per 100,000, representing a two-fold increase from the year 2000, and suicide was the leading cause of death among people in their teens in South Korea [3]. Because the suicide rate has recently increased in adolescents and young adults, the socioeconomic burden is increasing, and the problem has become public [1–3]. Suicidal ideation is a risk factor for suicide attempts. Suicidal ideation first emerges in adolescents, and the prevalence of suicidal ideation is higher in adolescence than at other ages. [4]. Factors associated with

adolescent suicide include psychiatric illness such as depression, ADHD, physical illness such as seasonal allergies, and socio-cultural problems such as excessive Internet use, social alienation, and peer victimization [5,6].

Significant seasonal peaks in suicide have consistently been identified in many countries [7]. The seasonality of suicide tends to coincide with seasonal allergens that peak dramatically in the spring and late summer/early fall [8,9]. One hypothesis is that cytokines released in allergic reactions affect depression associated with suicidal ideation and suicide [10,11]. In addition, suicidal ideation was independently associated with seasonal allergies after controlling for depression [12]. Other factors may affect the relation between seasonal allergies and suicidal ideation. Recently, Internet use has been increasing, and excessive Internet use is a cause of suicide in adolescents, particularly in Asia [13]. Many other studies have showed suicidal ideation to be among the most significant risk factors for suicide attempts and suicide although there is some controversy regarding this factor [14–17].

The Korea Internet Security Agency reported that the number of Internet users is increasing rapidly in Korea, and 99.9% of teenagers used the Internet in 2011 [18]. Excessive

Conflicts of Interest: All authors declare that they have no conflicts of interest.

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Internet use can have deleterious effects on adolescents' psychosocial development and behavior [19]. Excessive Internet use is a problem characterized by poorly controlled preoccupation and urges. Excessive Internet use is similar to Internet addiction [20]. The definition of 'Internet addiction' proposed by Young is that online users can become addicted to the Internet in the same manner that others become addicted to drugs or alcohol, resulting in academic, social, and occupational impairment [21]. In the fifth edition of Diagnostic and Statistical Manual of Mental Disorders released in 2013, the American Psychiatric Association considered Internet gaming disorder a condition worthy of future study [22]. Severe Internet addiction is known to be related to various psychiatric diseases such as depression, anxiety, sleep disorders, and attention deficit hyperactivity disorder [23]. Internet addiction presents psychological features that hinder schoolwork, daily living, and personal relations [24]. Specific Internet pathways such as pro-suicide websites and online suicide pacts increase the risk of suicidal ideation and behaviors in adolescents and young people [13].

Adolescents who have chronic allergic disease may have more exposure to the Internet because use of the Internet may help them endure personal problems associated with the disease [24]. However, this exposure may also increase their risk of addiction, and allergy is related to diverse addictions in adulthood [25]. Although the relation between allergic disease and suicidal ideation has been investigated, the effect of excessive Internet use on the relation between allergic disease and suicidal ideation has not been examined. The purpose of this study is to evaluate the relation between suicidal ideation and allergic disease in adolescents and to identify the effect of excessive Internet use on the relation between allergic diseases and suicidal ideation using Korean representative data.

## 2. Methods

### 2.1. Participants and procedures

This study was conducted using data from the 2010 Korean Youth Risk Behavior Web-Based Survey (KYRBWS), which has been conducted annually by the Korea Centers for Disease Control and Prevention since 2005. The 2010 KYRBWS was performed from September 2010 to October 2010. The KYRBWS was administered to a nationally representative sample of middle and high school students using a complex sampling design involving stratification, clustering and multi-stage sampling. Students completed an online questionnaire that guaranteed anonymity. This Web-based survey comprised 128 questions and 14 areas of health-related behaviors. Selected to participate in this survey were 74,980 students from 400 middle schools and 400 high schools. The response rate was 97.7%; 73,238 students participated in the survey. Additional information regarding the methodology and procedure of the survey are available in the survey summaries of the Korea Centers for

Disease Control and Prevention [26]. Ethical approval was not required for this secondary data analysis because the 2010 KYRBWS for the analysis did not collect any personal information and was previously conducted with the approval of the research ethical review board of the Korean Centers for Disease Control and Prevention. The data can easily be accessed for public use on the website (<http://yhs.cdc.go.kr>).

### 2.2. Measures

#### 2.2.1. Excessive Internet use

The Korean Internet Addiction Proneness Scale for Youth-Short Form: Self Report (KS Scale) was used to assess experiences of excessive Internet use at normal times. The KS Scale was developed by the Korean National Information Society Agency. Each question was scored on a four-point scale, with more points indicating a higher risk of Internet addiction. The KS Scale comprises 20 questions for each of six categories: tolerance, withdrawal, addictive automatic thought, disturbance of adaptive function, deviant behaviors, and virtual interpersonal relationships. The total scores were used as a continuous variable in this study. The Cronbach's alpha score of the KS scale was 0.909 at the time of development [27] and was 0.923 for this study.

#### 2.2.2. Allergic disease

Self-reported asthma was evaluated by the following question: 'Have you ever been diagnosed with asthma by a doctor?' Asthma was assumed by a 'yes' response to the question. Allergic rhinitis was defined as a 'yes' response to the question, 'Have you ever been diagnosed with allergic rhinitis by a doctor?' Atopic dermatitis was defined as a 'yes' response to the question, 'Have you ever been diagnosed with atopic dermatitis by a doctor?'

#### 2.2.3. Suicide ideation

Respondents were asked whether they had thought of suicide in the last year, to which they responded 'yes', 'no'.

#### 2.2.4. Socio-demographic variables

Socio-demographic variables included age, gender, region of residence, type of school, perceived family economic status, and perceived academic performance. Self-rated academic performance was a five-category variable from very high to very low.

### 2.3. Statistical analysis

In the 2010 KYRBWS, adjusted weights were applied to the data to obtain a representative sample of the Korean population. Before complex sample logistic regression, we prepared the plan file as a source of the analysis using three values, including weights, stratification variables and primary sampling units. Missing data were included in the complex sample analysis to maintain the representative character of the data for South Korea because each case in the data had a weighted value. A complex sample logistic regression was used to determine the relation between

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